

CLAIMS

WE CLAIM:

1. A method of coating a pipeline interior surface, comprising:
spraying a coating towards a pipe interior surface; and
providing a volume of reduced air pressure to draw any overspray from an interior area of said pipe.
2. The method according to claim 1, wherein spraying a coating towards an interior surface comprises placing a spray gun configured to spray said coating on an extension arm and inserting said extension arm into said interior area.
3. The method according to claim 2, wherein providing said volume of reduced pressure comprises providing a reduced air pressure zone adjacent said extension arm.
4. The method according to claim 3, wherein providing said reduced pressure zone is adjacent said extension arm comprises providing a reduced pressure zone proximate said spray gun.
5. The method according to claim 2, wherein said placing a spray gun comprises placing a thermal spray gun.
6. The method according to claim 5, further comprising cooling said thermal spray gun.
7. The method according to claim 5, further comprising cooling said extension arm separately from said thermal spray gun.
8. The method according to claim 1, further comprising flushing said interior area of said pipe with cooling air.

9. The method according to claim 8, further comprising directing said cooling air into said interior area of said pipe from at least one cooling air outlet disposed on said extension arm.

10. The method according to claim 8, further comprising directing said cooling air into said interior area from an opening into said pipe.

11. The method according to claim 8, further comprising adding a water mist to said cooling air.

12. The method according to claim 2, wherein spraying a coating comprises spraying a conductive material.

13. A method of forming conductive traces on a pipeline interior surface, comprising:
depositing and consolidating a substantially continuous elongated conductive layer of a conductive material upon an interior surface of a pipe to form a conductive trace.

14. The method according to claim 13, further comprising depositing and consolidating an insulating layer of an insulating material upon an interior surface of a pipe prior to depositing said conductive layer and then depositing said conductive layer over said insulating layer.

15. The method according to claim 14, wherein depositing said insulating layer comprises spraying said insulating material towards said interior surface.

16. The method according to claim 15, wherein spraying said insulating material comprises:
placing a spray gun configured to spray said insulating material on an extension arm;

inserting said extension arm into said interior area; and
operating said spray gun to spray said insulating material.

17. The method according to claim 16, further comprising providing a volume of reduced air pressure adjacent said extension arm to draw any overspray of said insulating material from said interior area.

18. The method according to claim 17, wherein providing said volume of reduced air pressure adjacent said extension arm comprises disposing a reduced pressure zone proximate said spray gun.

19. The method according to claim 16, wherein placing a spray gun comprises placing a thermal spray gun.

20. The method according to claim 19, further comprising cooling said thermal spray gun.

21. The method according to claim 19, further comprising cooling said extension arm separately from said thermal spray gun.

22. The method according to claim 20, wherein depositing said conductive layer comprises spraying said conductive material towards said interior surface.

23. The method according to claim 22, wherein spraying said conductive material comprises:

attaching a spray gun configured to spray said conductive material on an extension arm;
inserting said extension arm into said interior area; and
operating said spray gun to spray said conductive material.

24. The method according to claim 23, further comprising providing an area of reduced air pressure adjacent said extension arm to draw any overspray of said conductive material from said interior area.

25. The method according to claim 24, wherein providing said volume of reduced air pressure adjacent said extension arm comprises disposing a reduced air pressure zone proximate said spray gun.

26. The method according to claim 23, wherein attaching a spray gun comprises attaching a thermal spray gun.

27. The method according to claim 26, further comprising cooling said thermal spray gun.

28. The method according to claim 27, further comprising cooling said extension arm separately from said thermal spray gun.

29. The method according to claim 13, further comprising flushing said interior area with cooling air.

30. The method according to claim 29, further comprising directing said cooling air into said interior area from at least one cooling air outlet disposed on said extension arm.

31. The method according to claim 29, further comprising directing said cooling air into said interior area from an opening into said pipe.

32. An interior surface thermal spray system, comprising:
an extension arm;
a thermal spray gun mounted on said extension arm, said thermal spray gun including a spray gun cooling system; and

an extension arm cooling system for cooling said extension arm.

33. The interior surface thermal spray system of claim 32, wherein said thermal spray gun is a plasma spray gun, a high velocity oxy fuel spray gun, a two wire arc spray gun, a single wire arc spray gun, or a flame spray gun.

34. The interior surface thermal spray system of claim 32, wherein said spray gun cooling system comprises a fluid circulating system for circulating a coolant fluid from a remote coolant source through a feed line to said thermal spray gun and from said spray gun to a return line.

35. The interior surface thermal spray system of claim 34, wherein said feed line and said return line are contained inside said extension arm.

36. The interior surface thermal spray system of claim 32, wherein said extension arm cooling system comprises a fluid circulating system for circulating an extension arm coolant fluid from a remote coolant source to an extension arm feed line through said extension arm and to an extension arm return line.

37. The interior surface thermal spray system of claim 36, wherein said extension arm feed line and said extension arm return line are contained inside said extension arm.

38. The interior surface thermal spray system of claim 32, further comprising a longitudinal slide track attached to said extension arm for extension and retraction of said extension arm in a longitudinal direction.

39. The interior surface thermal spray system of claim 38, further comprising an orthogonal slide track attached to said extension arm for movement of said extension arm in a direction substantially orthogonal to said longitudinal direction.

40. The interior surface thermal spray system of claim 38, further comprising a controller for substantially simultaneously controlling operation of said spray gun and movement of said extension arm.

41. The interior surface thermal spray system of claim 40, wherein said controller comprises at least one software program executed by a microprocessor.

42. The interior surface thermal spray system of claim 32, wherein said thermal spray gun is mounted on said extension arm with a telescopic mount for extending and retracting said thermal spray gun with respect to said extension arm.

43. The interior surface thermal spray system of claim 32, wherein said thermal spray gun is mounted on said extension arm by at least one gimbal for orienting said thermal spray gun in multiple directions relative to said extension arm.

44. The interior surface thermal spray system of claim 32, further comprising a collector shroud disposed upon said extension arm.

45. The interior surface thermal spray system of claim 44, wherein said collector shroud is disposed around said thermal spray gun.

46. The interior surface thermal spray system of claim 32, further comprising a cooling air flushing system configured to flush an interior area of a conduit with cooling air.

47. The interior surface thermal spray system of claim 46, wherein said cooling air flushing system comprises at least one cooling air outlet disposed on said extension arm.

48. An interior surface spray system, comprising:
an extension arm;
a spray gun mounted on said extension arm; and

an overspray collector shroud disposed to draw any overspray of material sprayed by said spray gun.

49. The interior surface spray system of claim 48, wherein said overspray collector shroud is disposed on said extension arm.

50. The interior surface spray system of claim 49, wherein said overspray collector shroud is disposed around said spray gun.

51. The interior surface spray system of claim 48, wherein said spray gun is a thermal spray gun.

52. The interior surface spray system of claim 51, wherein said thermal spray gun is a plasma spray gun, a high velocity oxy fuel spray gun, a two wire arc spray gun, a single wire arc spray gun, or a flame spray gun.

53. The interior surface spray system of claim 51, further comprising a spray gun cooling system.

54. The interior surface spray system of claim 53, wherein said spray gun cooling system comprises a fluid circulating system for circulating a coolant fluid from a remote coolant source through a coolant feed line to said thermal spray gun and from said thermal spray gun to a coolant return line.

55. The interior surface spray system of claim 54, wherein said coolant feed line and said coolant return line are contained inside said extension arm.

56. The interior surface spray system of claim 48, further comprising an extension arm cooling system.

57. The interior surface spray system of claim 56, wherein said extension arm cooling system comprises a fluid circulating system for circulating an extension arm coolant fluid from a coolant source to an extension arm feed line through said extension arm and to an extension arm return line.

58. The interior surface spray system of claim 57, wherein said extension arm feed line and said extension arm return line are contained inside said extension arm.

59. The interior surface spray system of claim 52, further comprising a longitudinal slide track attached to said extension arm for extension and retraction of said extension arm in a longitudinal direction.

60. The interior surface spray system of claim 59, further comprising an orthogonal slide track attached to said extension arm for movement of said extension arm in a direction orthogonal to said longitudinal direction.

61. The interior surface spray system of claim 59, further comprising a controller for substantially simultaneously controlling operation of said spray gun and movement of said extension arm.

62. The interior surface spray system of claim 61, wherein said controller comprises at least one software program executed by a microprocessor.

63. The interior surface spray system of claim 48, wherein said spray gun is mounted on said extension arm with a telescopic mount for extending and retracting said spray gun with respect to said extension arm.

64. The interior surface spray system of claim 48, wherein said spray gun is mounted on said extension arm by at least one gimbal for orienting said spray gun in multiple directions relative to said extension arm.

65. The interior surface spray system of claim 48, further comprising a cooling air flushing system configured to flush an interior area of a conduit with cooling air.

66. The interior surface spray system of claim 65, wherein said cooling air flushing system comprises at least one cooling air outlet disposed on said extension arm.

67. The interior surface spray system of claim 48, further comprising at least one stand for supporting a conduit for coating of an interior surface of said conduit.

68. The interior surface spray system of claim 67, wherein said at least one stand further comprises at least one roller for rotating said conduit on said stand.